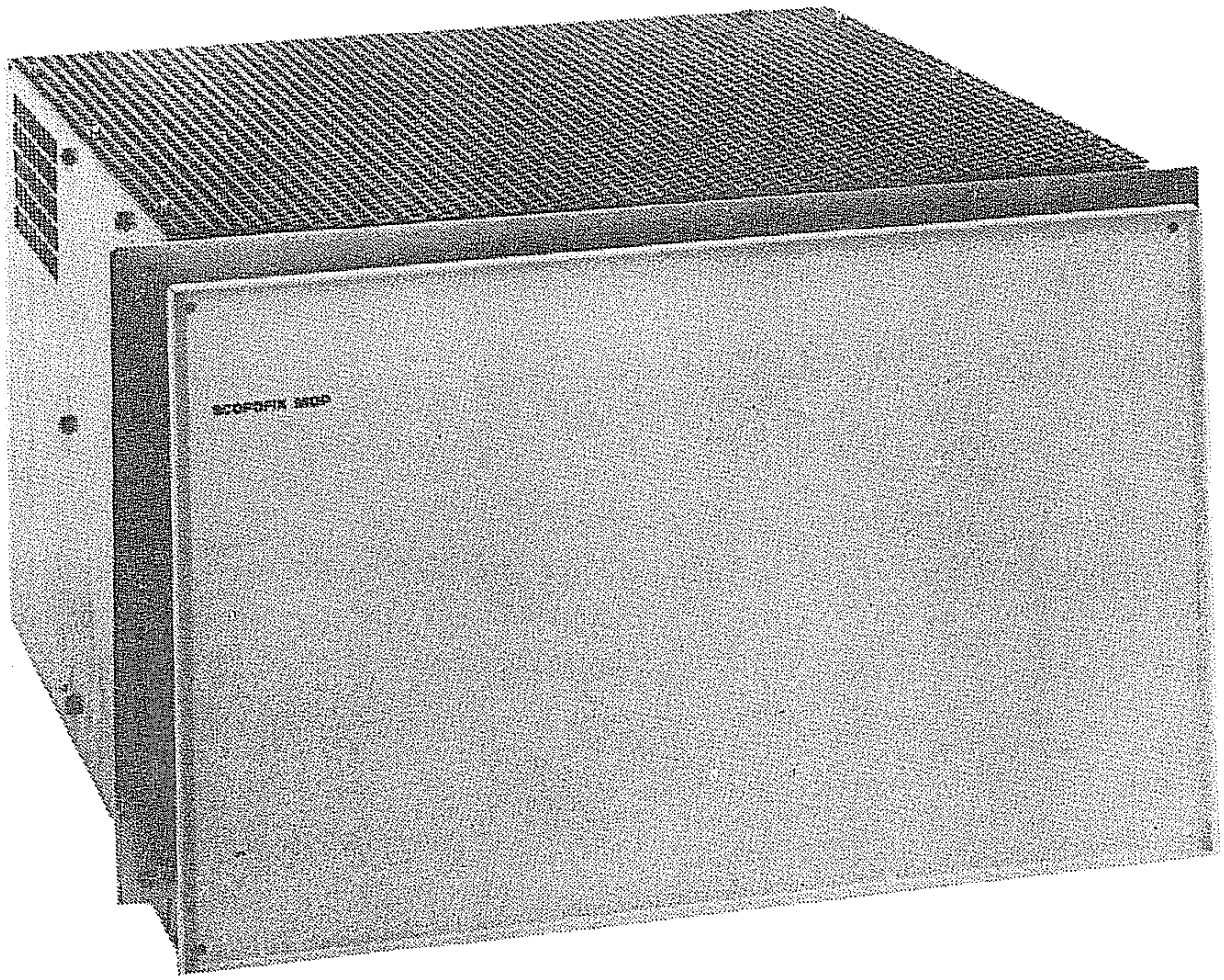
SERVICE MANUAL-UNIT

DIGITAL SCOPOFIX MDP

9807 721 0.001



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SERVICE MANUAL-UNIT
DIGITAL SCOPOFIX MDP
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1. INTRODUCTION AND TECHNICAL DATA

1.1. PURPOSE

The Medical Dual image Processor 9807 721 00001 is a digital video-image memory with image processing capabilities, for use in surgical X-Ray systems and kidney Lithotripler.

1.2. ITEMS SUPPLIED

- MDP built in a rack.
- Front plate.
- Installation material :
  4x screw M4 to mount the frontpanel.
  4x screw M6 to mount the MDP-rack in the BV 25 trolley.

1.3. EQUIPMENT IDENTIFICATION

The type numberplate is mounted on the front (left inside) of the rack.

1.4. TECHNICAL DATA

1.4.1. Dimensions

Height: 300 mm
Width : 412 mm
Depth : 435 mm
Weight: 25 kg

1.4.2. Electrical Data

(1) The MDP-unit comprises:
- Powersupply.
- Controller pcb.
- Noise reducer pcb.
- Two memory pcb's.
- Subtract pcb.
- Local Control pcb.
- AD pcb.

(2) Power supply:
Supply voltage : 220V ± 10% 50/60 Hz
Supply current : < 2A
Turn on current: < 25A
Leakage current: < 3.5 mA.

(3) Video input (connector WHD-X3) :
Source impedance: 75 Ohm
Video amplitude : 1100 mV ± 5%
Sync amplitude : 300 mV ± 50 mV
TV-line systems : CCIR 625 lines/ 50 Hz interlaced or
2x 313 lines/ 50 Hz non-interlaced
EIA 525 lines/ 60 Hz interlaced or
2x 263 lines/ 60 Hz non-interlaced

(4) Video output 1 and 2 (connector WHD-X4, WHD-X5) :
Impedance : 75 Ohm
Bandwidth : 8 Mhz
Video amplitude: 1100 mV ± 5%
Sync amplitude : 300 mV ± 50 mV.

(5)Remote control interface (connector WHD-X2):
- All command lines are 5V LOCMOS-compatible and active HIGH.
- All inputs are low pass filtered.
- Input impedance : 47 Kohm.
- Input voltage HIGH : >3.5V.
- Input voltage LOW : <1.5V.
- All outputs are buffered and protected with diodes.
- Output voltage HIGH : >3.5V (at -1mA).
- Output voltage LOW : <0.5V (at +1mA).

INPUT		OUTPUT	
function	pin	function	pin
START	08	Ident 1	38
MEM1	10	Ident 2	40
MEM2	11	Ident 3	42
LIH	13	Ident 4	44
ER	14	Ident 5	46
NR 1	19	Ident 6	48
NR 2	20	Ident 7	50
NR 3	21	Ident 8	49
NR 4	22	BUSY	37
GAMMA 1	24	+5V/500 ohm	30,32
GAMMA 2	25	SPARE1	31
SUB1	27	SPARE2	35
SUB2	28	disk option	33
INVERT	16	0V	29,34,36,39,43,47
TRACE	12		
disk option	02,04,06		
reserved	41,45		
0V	1,3,5,7,9,15,18,23,26		

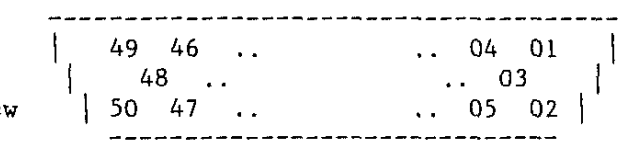


Figure 1.1 : Remote control interface connector WHD-X2.

8 lines are reserved for automatic identification of the different memory units.

Ident 1 : Single frame store + averaging
2 : Dual frame store + averaging + integration
3 : Disk option
4 : Subtraction
5 : Zoom option (future feature)
6 : Gamma correction
7 : Contour correction (future feature)
8 : Spare

1.4.3. Environmental Data

Ambient operating temperature: +10 °C to +40 °C.
Relative humidity: 85% RH.

1.4.4. Applicable Standards

- UL 478.
- CSA C22.2 nr. 154.
- HHS certified.
- IEC 435.
- CISPR 11 and 11A.
- FCC rules CFR 47 part 2 and 15.
- VDE 871 level B.

2. INSTALLATION

2.1. INTRODUCTION

The instructions to install the MDP-unit in a system will be found in the Service Manual of that particular system.

2.2. TOOLS AND TEST EQUIPMENT

This equipment can be installed with a standard toolset.

2.3. PROGRAMMING FACILITIES

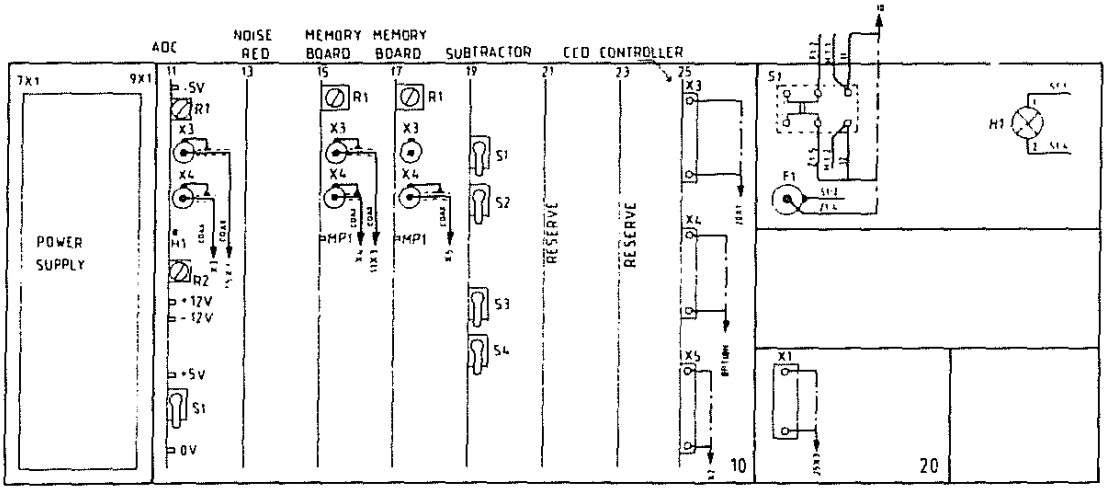


Figure 2.1 : Switches and jumpers at the front of the rack.

(1) Controller-board (WHD25)
Dependent upon the TV-Line system of the applied video the jumper WHD25:W1 has to be set in the position 1-2 (50 Hz) or 1-3 (60 Hz).

(2) AD-board (WHD11)
Switch WHD11:S1 gives the service engineer the possibility to use a video test-pattern.

(3) Subtractor-board (WHD19)
Figure 2.2 gives a simplified diagram to locate the electrical position of the switches WHD19:S1-S4.
Figure 2.3 explains the function of the switches WHD19:S1-S4.

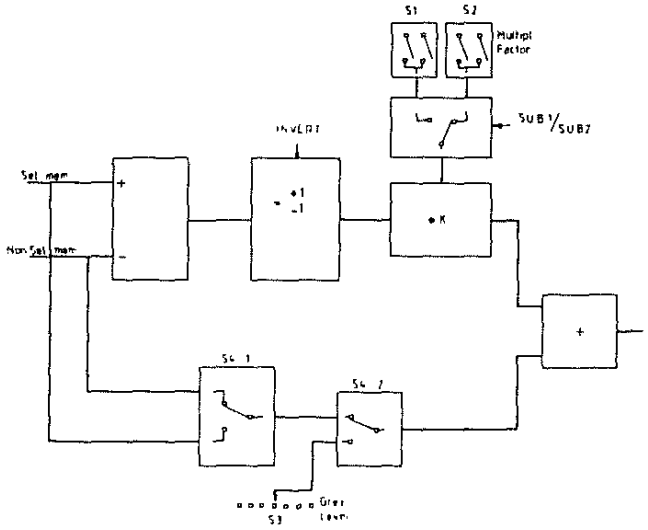


Figure 2.2 : Simplified diagram of the Subtractor-board (WHD19).

switch	select	selected function
S1		multipl. fact. (SUB1)
	0	4
	1	2
	2	1
	3	0.5
S2		multipl. fact. (SUB2)
	0	4
	1	2
	2	1
	3	0.5
S4.2	open	selection from S4.1
	closed	selection from S3
S4.1	open	selected memory
	closed	non selected memory
S3	0	black
	1	
	.	grey level
	.	step ± 69 mV
	.	0 - 94 %
	E	
	F	white

Figure 2.3 : Function of the switches S1-S4 on the Subtractor-board (WHD19).

2.4. INSTALLATION INSTRUCTION

- Mount the unit as described in the system Service Manual.
- Set jumper WHD25:W1 on the controller-board (WHD25) on 1-2 (50Hz) or 1-3 (60Hz).
- Check the off-position of the switch WHD11:S1 on the AD-board.
- Set the switches on the subtractor-board (WHD19) in the position required for application (system requirement). The factory settings of the switches is given in figure 2.4.

switches	position	function
S1	2	multipl. fact. 1 for SUB1
S2	1	multipl. fact. 2 for SUB2
S3	3	non selected memory added as background.
S4.1	closed	
S4.2	open	

Figure 2.4. : Factory settings of the switches S1 - S4 on the Subtractor-board (WHD19).

- Connect the cables at the rear of the MDP-rack. (fig. 2.5.)

Connector MDP	Function
WHD-X1	220V supply
WHD-X2	system interface
WHD-X3	video input
WHD-X4	video output 1
WHD-X5	video output 2

Figure 2.5 : The connections at the rear of the MDP-rack.

WARNING

When the 220V supply-cable (WHD-X1) has been connected, some parts of the unit will have a 220V tension (also when the power switch is in the of position).

3. SETTING TO WORK

3.1. INTRODUCTION

The pcb's are factory adjusted but in case of a distortion it can be nescessary to readjust. Therefore in section 4. CORRECTIVE MAINTENANCE an additional description for some adjustments is given.

NOTE

The unit does not work properly with pcb's on extender boards because of the high frequency used.

3.2. EQUIPMENT REQUIRED

- standard toolset

3.3. CONTROLS AND INDICATORS

(1) AD-board (WHD11)
- Led WHD11:H1 is lit when the PLL-oscillator is not locked with the incoming video (fig. 3.1.).

(2) Local Control-board
On the Local Control-board commands can be given to initiate the unit. Local Control commands are overruled by Remote Control commands.

- DIGITAL BYPASS -
(video in - ADC - DAC - video out, without memory store)

deactivate all local commands (no LED's on the Local Control board are lighting).

- PROCESSING FUNCTIONS -

. Gamma correction
activate GAMMA1 (curve 1) or GAMMA2 (curve 2)

Curve 1 is intended for contrast enhancement.
Curve 2 is intended for correction of film non-lineairity in hard copy units.

. Subtraction
activate MEM1 or MEM2, activate SUB1 or SUB2
activate or deactivate INVERT

- NOISE REDUCTION -

. Last image hold
select a memory (MEM1 or MEM2), activate LIH and START
select noise reduction grade
    NR1: K=1/2
    NR2: K=1/4
    NR3: K=movement defined (K=1/4 -> 1/2)
    NR4: K=movement defined (K=1/8 -> 1/4)
no selection of noise reduction grade : K=1

. Electronic Radiography
select a memory, activate ER and START
select number of images for integration
NR1: N=2
NR2: N=4
NR3: N=8
NR4: N=16

. Trace
select a memory, activate TRACE and START
select white or black
NR1: white
NR2: black
NR3, NR4 or no selection disables the TRACE

3.4. ADJUSTMENT FACILITIES

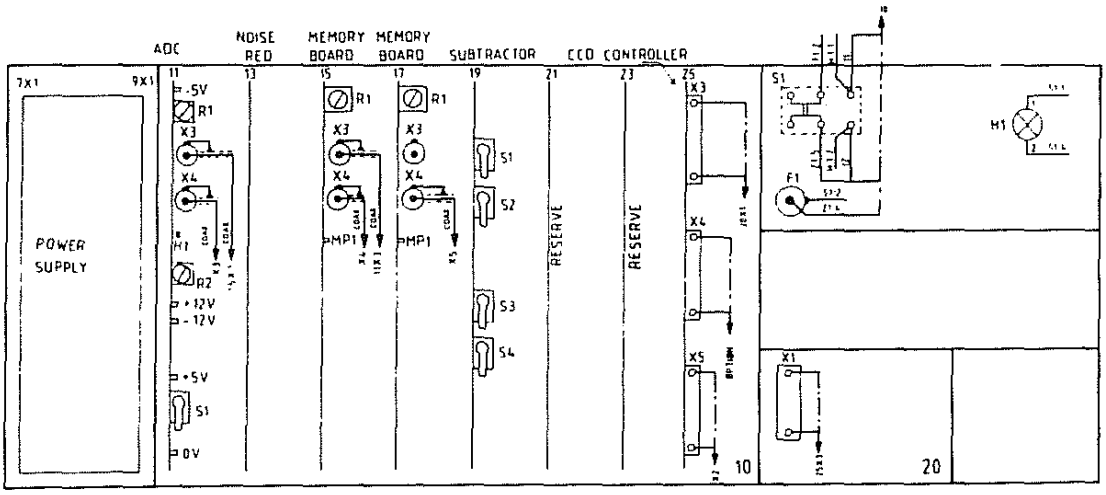


Figure 3.1 : Adjusting points at the front of the rack.

(1) AD-board (WHD11)
- Potentiometer WHD11:R1 adjusts the maximum amplitude for the AD convertor (factory adjusted to video amplitude of 1100 mV).
- Potentiometer WHD11:R2 adjusts the zero level for the AD convertor (factory-adjusted).
- Measuring points on front of board : WHD11:+5V, -5V, +12V and -12V.
- Capacitor WHD11:C94 adjusts the frequency of the PLL-oscillator (factory-adjusted).

(2) Memory-board 1 (WHD15) and 2 (WHD17)
- WHD15/17:R1 adjusts the output amplitude (factory-adjusted to 1100 mV).
- WHD15/17:MP 1 measuring point for video output.

3.5. SETTING UP AND TESTING

- Switch power off.
- Check the correct settings of jumpers and switches as described in section 2. INSTALLATION
- Switch power on. All LED's on the Local Control board are on for about 1 sec.
- For a new delivered unit the AD- and Memory-boards are factory-adjusted to an input-to-output ratio of 1 (at 1100 mV), and need no further adjustment.
- Check all the processing functions mentioned in chapter 3.3. CONTROLS AND INDICATORS.

4. CORRECTIVE MAINTENANCE

4.1. INTRODUCTION

This section gives procedures for adjustments, replacements and identification of a faulty power supply or faulty pcb's. It is the intension that pcb's are to be replaced and not repaired.

4.2. EQUIPMENT REQUIRED

- standard toolset
- multimeter (Ri>10 Mohm)
- oscilloscope (dual channel)

4.3. ADJUSTMENTS

For the correct adjustment it is nescessary to follow the sequence of the procedure :

(1) Output gain
(2) Input offset
(3) Overall gain

During the adjustments the outputs WHD:X4 and WHD:X5 of the unit should be connected to either a 75 ohm impedance or a monitor.
If measuring point WHD15/17:MP 1 on the Memory boards causes to much noise in the video-output signal, use the output connector (WHD:X4 or WHD:X5).

(1) Output gain
- Switch the power on.
- Set on the AD-board the switch WHD11:S1 on test.
- Connect measuring point WHD15:MP 1 of Memory 1 or output WHD:X4 to channel A of an oscilloscope.
- Measure a staircase pattern like the one in fig. 4.1.
- Adjust with potentiometer WHD15:R1 on Memory 1 the maximum amplitude of the signal to 1100 mV.

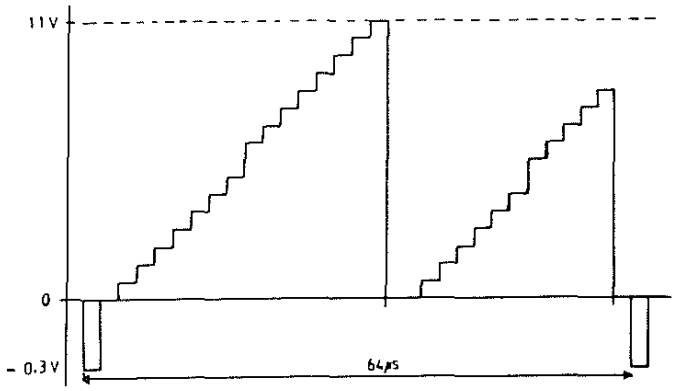


Figure 4.1 : The generated test-pattern.

- Connect measuring point WHD17:MP 1 of Memory 2 or output WHD:X5 to channel B of the oscilloscope.
- The pattern on channel B must be covering the pattern on channel A. This can be accomplished by the adjustment of potentiometer WHD17:R1 on Memory 2.
- Switch the test-switch WHD11:S1 off.

(2) Input offset
- Disconnect any input-signal on connector WHD:X3 of the unit.
- Turn the potentiometer WHD17:R2 on the AD-board fully counter clock wise (ccw). On the oscilloscope a DC-level with sync-pulses appears.
- Turn the potentiometer WHD17:R2 slowly clock wise (cw). The DC-level will decrease with steps of 4 mV. (Can only be seen with a 1:1-probe).
- Turn the potentiometer WHD17:R2 cw until the DC-level equals zero.

(3) Overall gain (1:1)
- Apply on WHD:X3 video (from the system).
- Measure on WHD:X3 and on WHD17:MP 1 of Memory 2 or output WHD:X5 the amplitude of the video-signal.
- Adjust with potentiometer WHD11:R1 on the AD-board the input gain. The input/output-ratio must be 1.
- Check the adjustment procedure as follows.
- Change the connection of the oscilloscope from Memory 2 to Memory 1 and measure the amplitude of the output video signal from Memory 1.
- If both ratio's are 1 then the adjustments are correct. If not, then the total adjustment procedure has to be repeated.

4.4. REPLACEMENTS

Sometimes inserting of the power supply unit in the glider entry causes problems. It is possible to remove the front support (plate) of the unit first. After placing the unit in the glider, the support can be mounted again.

4.5. FAULT FINDING PROCEDURE

4.5.1. Introduction

- Disconnect the remote control connector (WHD-X2) to enter test mode.

WARNING

Although the powerswitch is in the off-position, some parts of the unit still have a 220V tension.

CAUTION

Before inserting, connecting or disconnecting boards or wiring always switch off the power supply.

NOTE

The unit does not work properly with pcb's on extender boards because of the high frequency used.

4.5.2. Power supply

(see 4.5.1. Introduction WARNING, CAUTION and NOTE)

- Remove front cover and switch the unit on.
- Check if 220V is present (watch the neon indicator).
- Measure on the measuring points WHD11: +12V, +5V, -5V and -12V of the AD-board if the correct voltages are present (tolerance ± 5%).
- When the correct voltages are not present, disconnect the flatcable connections at the Controller (WHD25). Measure again the voltages. When correct, the Local Control board or the flatcables are defective. Replace or change successively.
- When still not correct, disconnect with the exception of the AD-board (WHD11) all the boards. Measure again the voltages. When correct, one of the boards is defect. Replace successively to find out which one.
- In case of fault change successively the AD-board and power supply. If the voltages are still not present the backpanel or wiring is defective.
- Switch the power off.

NOTE

After using a new AD-board and/or a new power supply it may be nescessary to adjust the offset of the ADC (see chapter 4.3).

4.5.3. MDP-function

(see 4.5.1. Introduction WARNING, CAUTION and NOTE)

- Remove the front cover and switch the unit off.
- Disconnect/remove with the exception of the AD-board all the boards.

(1) Controller/Local Control-board
- Boards connected : AD-board (WHD11)

- Insert the Controller-board (WHD25) and connect the Local Control-board (WHD20).
- Switch the power on. All LED's on the Local Control-board are on for about 1 sec. After that time they should ALL be off.
- If this has not happened, change successively, after the power has been switched off, the AD-, Controller- and Local Controller-board and the flat-cable connection.
- Test again. If the problem is not solved, the backpanel is defective.

(2) Analog bypass (fig. 4.1.).
- Boards connected : AD-board (WHD11)
  Controller (WHD25)
  Local Control-board (WHD20)

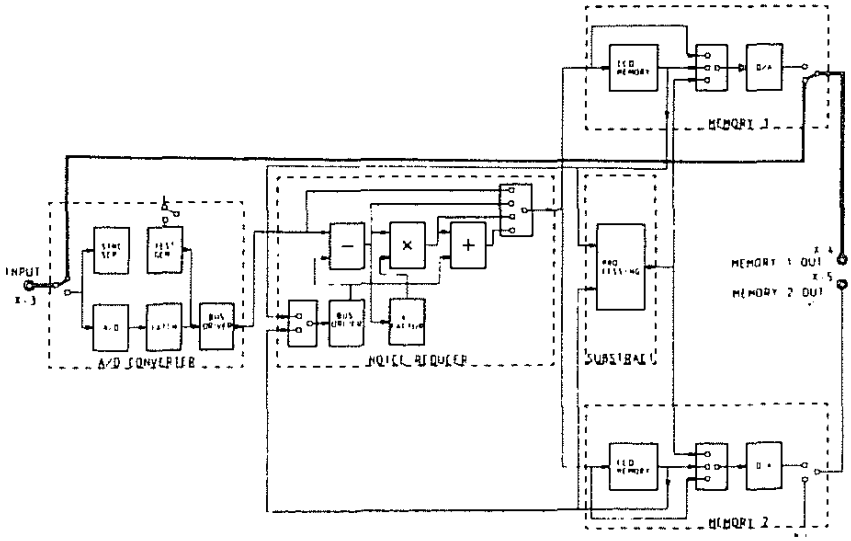


Figure 4.1 : Analog bypass.

- Switch the power off.
- Insert Memory 1 (WHD15) and connect the video-cables between the AD-board (WHD11) and Memory 1 (WHD15) and between Memory 1 (WHD15) and connector WHD:X4.
- Apply a video-signal to connector WHD:X3 of the unit.
- Watch the output-video from connector WHD:X4 on a monitor. If this is not present :
  . inputrelais AD-board defective.
  . outputrelais Memory 1 defective. Exchange Memory boards to check.
  . video-cables defective.

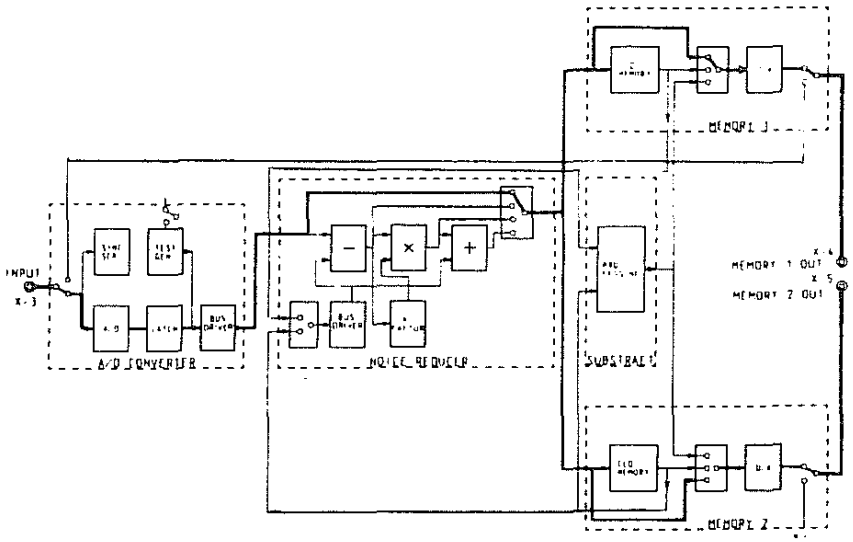


Figure 4.2 : Digital bypass.

(3) Digital bypass (fig. 4.2).
- Boards connected : AD-board (WHD11)
  Controller (WHD25)
  Local Control-board (WHD20)
  Memory 1 (WHD15)

- Insert the Noise Reducer-board (WHD13), the second Memory-board (WHD17) and connect the video-cables between Memory 2 (WHD17) and connector WHD:X5.
- Switch the power on. Check again if all LED's on the Local Control-board (WHD20) are on for about 1 sec., when not exchange the AD-board (WHD11).
- Video must be again present on connector WHD:X4 and because of the second Memory also on connector WHD:X5. If the video is not present a Memory-, AD- or Noise reducer-board can be defective.

(4) Test generator (fig. 4.3a)
- Boards connected : AD-board (WHD11)
  Controller (WHD25)
  Local Control-board (WHD20)
  Memory 1 (WHD15)
  Memory 2 (WHD17)
  Noise reducer (WHD13)

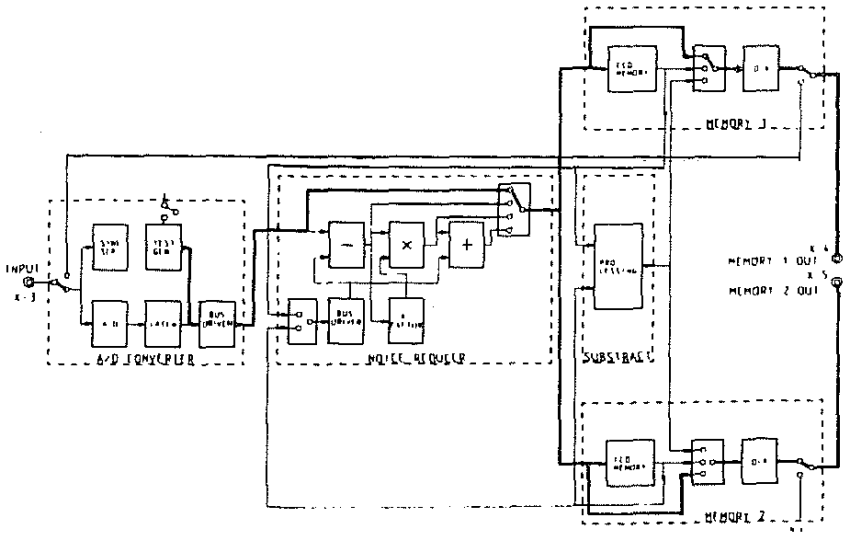
- Switch with the switch WHD11:S1 on the AD-board the test generator on. A staircase video-signal is generated, resulting in two white-to-black bar patterns on the monitor screen. If not the AD-board is defective.

(5) Noise reducer functions
- Boards connected : see (4) Test generator
  settings : switch WHD11:S1 -> on

- Press switch LER on the Local Control-board.
- Press switch LNR1 to select subtract circuit of Noise reducer-board and with a oscilloscope measure the signal on connector WHD:X4 or watch the monitor screen of Memory 1 (WHD15) (fig 4.3b). A DC-voltage of 550 mV with sync pulses can be measured or on the monitor a grey level can be seen.
- Press switch LNR2 to select add circuit in addition (fig 4.3c). Nothing should change.
- Press switch LNR3 to select multiplication circuit in addition (fig 4.3d). The original staircase can be measured or on the monitor the bar pattern can be seen.
- Press LER and LNR3 again to reset the functions.
- Repeat the test but instead of pressing key LER use key LLIH. Measure the signal on connector WHD:X5 or watch the monitor screen of Memory 2 (WHD17).
- When only function LER is faulty, change Memory 1 (WHD15). When only function LLIH is faulty, change Memory 2 (WHD17). When both functions are faulty, or when LNR1 works fine but LNR2 or LNR3 does not, change the Noise Reducer-board (WHD13).
- Repeat the tests. If there is still something wrong, change the backpanel.

(6) Subtractor-board
- Boards connected and settings : see (5) Noise reducer functions

- Switch the power off.
- Mark the settings of the switches WHD19:S1, S2, S3 and S4.2 of the Subtractor-board.
- Select "grey-level" (switch WHD19:S4.2 closed) and select 3 for the level with switch S3.
- Select for LSUB1 a multiplication factor 1 (switch WHD19:S1 position 2) and for LSUB2 a multiplication factor 2 (switch WHD19:S2 position 1).
- Insert the Subtractor-board.



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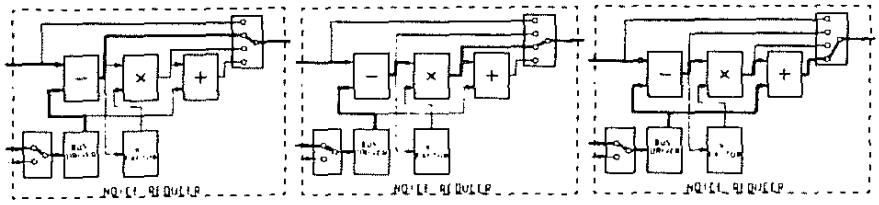

4.3b 4.3c 4.3d

Figure 4.3 : a) Test generator.
b) Test mode NR1.
c) Test mode NR2.
d) Test mode NR3.

- Disconnect the input video from WHD:X3, switch the power on and store the test-pattern in Memory 1 by pressing the keys LLIH, LMEM1 and twice LSTART on the Local Control-board.
- Switch off the test-pattern and store the black level in Memory 2 by pressing LMEM2 and twice LSTART.
- Subtract the memory-images by pressing key LSUB1.
- Return to memory 1 (LMEM1). The result is a new bar pattern. If we compare this pattern with the original one we can see that the new one has a much larger white bar which is the result of the addition of the grey level with the test-pattern.
- Repeat the subtract function. Instead of using LSUB 1 use the keys selections of fig. 4.4.

keys	clipped bar
SUB1	white (small)
SUB1, INVERT	black (large)
SUB2	white (medium)
SUB2, INVERT	black (very large)

Figure 4.4 : Keys on the Local Control-board.

- Switch the power off, pull out the Subtractor-board and exchange it when something was incorrect else reset the original switches settings and insert the board.

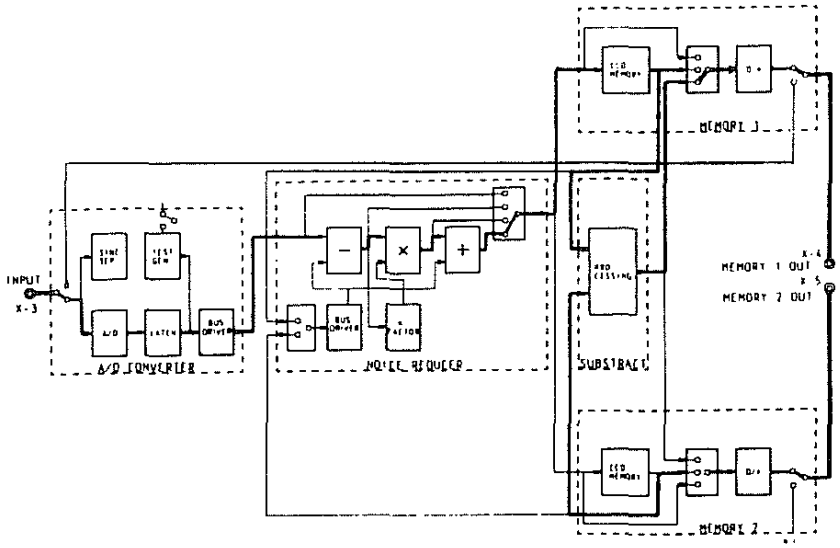

Figure 4.5 : Substraction.

(7) Gamma corrections
- All boards connected
  switch WHD11:S1 -> on

- Switch the power on.
- Select Memory 1 (LMEM1).
- Measure with an oscilloscope on connector WHD:X4. If you press one of the two gamma correction keys the level of some steps of the staircase will change. - Test both gamma corrections. When incorrect change Memory 1 (WHD15).
- Repeat the test for Memory 2. Select Memory 2 (LMEM2) and measure on WHD:X5.

5. CIRCUIT DESCRIPTION

See diagram Z1.2.

5.1. INTRODUCTION

In diagram Z1.2. 6 pcb's can be discerned (see also figure 5.1.). On the AD-Board the applied analog video-signal is converted into an 8 bit digital signal and sent to the Noise Reducer. On the Noise Reducer some noise reduction functions are possible, using the images coming from the AD-Board and from the selection of one of the two Memory-boards. The image at the output of the Noise Reducer is saved in the selected memory.
Each memory has a DAC, so the contents of each memory can be displayed on a monitor.
Using the Subtractor and the DAC on one of the two memory-boards, the contents of the memories can be subtracted and displayed on a monitor, without effecting the contents of the memories.
On the Controller a micro-processor is used for the mode selection and timing- and control-signals.

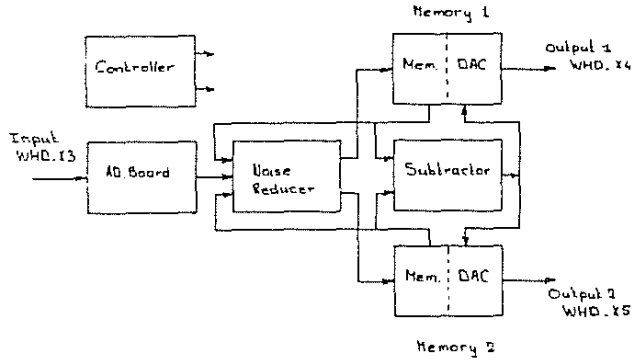

Figure 5.1 : Functional blockdiagram of the MDP-unit.

5.2. AD-BOARD

The input video is connected to WHD:X3 and via bypass- switch and buffer sent to the clamping circuit.
After clamping the video to 0 V, the video is converted into an 8 bit digital signal and buffered (outputbus AD-out 0 to 7).
For test purpose a digital staircase is generated (WHD11:S1 on TEST) resulting in two white-to-black bar patterns on the monitor.
The sync pulses from the video are separated into horizontal and vertical sync pulses and buffered (output signals V-pulse and H-pulse).
The sync detector/oscillator detects if no sync pulses are present and then generates X-tal controlled sync pulses.
The PLL-oscillator, locked by the horizontal sync, is running at a frequency of about 40 MHz; after clipping, pulse stretching, dividing by two and buffering we get signals CLOCK and CLOCK-N of 20 MHz.
The clock signals, sent to the processor and the memory boards, are synchronised with the incoming video-syncs.

5.3. NOISE REDUCER BOARD

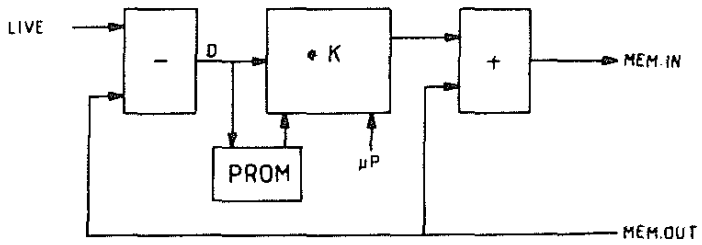

Figure 5.2 : Simplified diagram of the noise reducer.

The selected memory signal, from Memory 1 (WHD15) or Memory 2 (WHD17), is subtracted from the live signal and the result is multiplied with a factor K (0<K<1) and then added to the selected memory signal.

The factor K:
Moving K : Dependent upon the value of the subtracted signal (D) a PROM makes a K-factor (K=1/4 - 1/2).
Fixed K : Value K is supplied by the processor
Tracing K: The factor K is defined by the selection trace white/trace black and by the value of the subtracted signal D.
This results in storage of the minimum respectively maximum value of each pixel.

trace white	trace black
D>0 K=1	D>0 K=0
D<0 K=0	D<0 K=1

5.4. MEMORY BOARD (Memory1 and Memory2 are identical)

After buffering, the digital video is set in the Charge-Coupled-Device (CCD) memory. Via the output and input switches of the CCD memory (field 1 and 2) the memory is refreshed.
The output of the CCD memory is buffered and sent to the noise reducer and subtractor.
The selector switch chooses between the output of the CCD and the output of the subtractor.
The digital to analog convertor (DAC) gets his input from the selector switch which selects:

a. Input-video of memory.
b. Output-video of CCD memory/Output-video of subtractor.
c. Gamma corrected signal as b.

5.5. SUBTRACTOR BOARD

Figure 5.3 gives a siplified diagram of the subtractor.

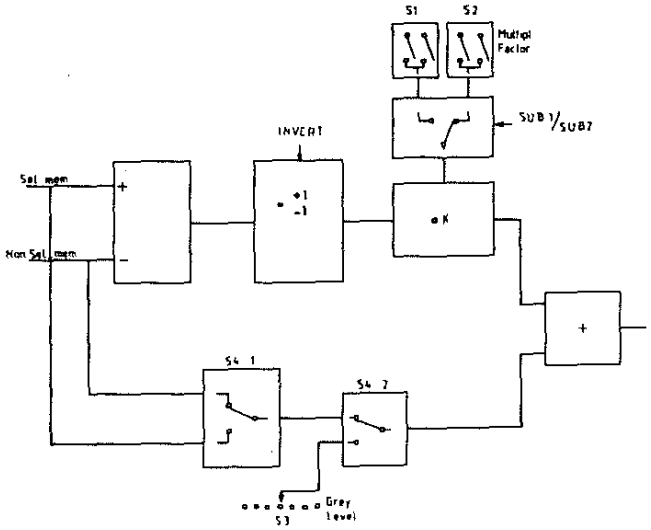

Figure 5.3 : Simplified diagram of the Subtractor.

With the switches S1 - S4 and the keys LMEM 1, LMEM 2, LSUB 1, LSUB 2 and LINVERT on the Local control-board the next algorithm can be filled in.

INVERT * (SEL - NON SEL) * MULT.FACTOR + ADDITION

- LMEM 1 or LMEM 2 is the memory which is marked as SEL (SELECTED). (NON SEL=NON SELECTED memory).
- LSUB 1 or LSUB 2 selects the multiplication factor which is set by the switches S1 and S2 (see fig. 5.3).
- LINVERT: non active= -1
  active= +1
- Addition is filled in by the switches S4.1, S4.2 and S3. (See fig. 5.3).

After latching memory 1 and 2, one of the memory busses is inverted and added to the other (non-inverted) memory bus resulting in : memory 1 - memory 2. The subtracted digital video-signal is multiplied by a factor 1/2, 1, 2 or 4 and added to a selected background. This selected background is one of the next three possibilities:

a. Image from memory 1.
b. Image from memory 2.
c. Grey-level.

If the subtracted and multiplied digital video signal is negative or the amplitude is too high, the signal is limited:
The negative signal is converted to black level and the signal level higher than the maximum amplitude is set to white level.

5.6. CONTROLLER BOARD

The microprocessor on the controller board is driven by clock pulses, being generated on the AD-board. Those pulses have been synchronised to the horizontal and vertical sync pulses of the video-signal. When no video sync pulses are present, then an internal generator on the AD-board supplies the sync-pulses.
On-board timers generate internal and external timing signals, which are transferred to the data control bus through output X2 A15 : C27.